KEY ENABLERS TO CONSIDER

The present roadmap development effort focused on AM technology, but through the roadmapping workshop process, participants identified several non-technology enablers that are critical to effective rollout of AM across DoD:

Data Management
Developing the policies, architectures, and procedures to properly manage massive, multimodal AM data.

Policy Change
Modifying organizational governance to realize the benefits of AM.

Cultural Change
Increasing knowledge of and comfort with AM, driving institutional acceptance.

Workforce Development
Readying the DoD workforce (acquisition, R&D, manufacturing, etc.) with the skills to harness AM.

RECOMMENDATIONS

Development
Create a coordinated DoD-wide plan for for advancing AM capabilities.

Initial Execution
Begin the execution of the DoD-wide plan for developing AM capabilities.

Continuous Improvement
Sustain the development of AM capabilities across the DoD and refine the approach to enhance flexibility and optimize ROI.

Context:

This information is based on the integrated DoD AM Technology Roadmap that was developed by USAF, US Army, DON, and DLA personnel participating in a series of participant-driven exercises led by America Makes on May 11th, 2016.

The group integrated objectives from their individual Service-level roadmaps into joint DoD objectives and corresponding technology elements, based on four focus areas. This infographic presents those integrated objectives in a novel format to emphasize overlap.

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AmericaMakes.us/dod-amroadmap

About America Makes

America Makes is a public-private partnership with a mission to accelerate the adoption of additive manufacturing technologies and increase U.S. manufacturing competitiveness.

America Makes
National Additive Manufacturing Innovation Institute
AmericaMakes.us

in partnership with
Deloitte.

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NCDMM
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America Makes

DoD Integrated Additive Manufacturing (AM) Technology Roadmap

STRATEGIC ALIGNMENT

The DoD's strategic goals – as articulated in the 2015-2018 Strategic Plan — are directly supported by the benefits of Additive Manufacturing (AM).

DoD Strategic Goals	Benefits of AM
Defeat our Adversaries, Deter War, and Defend the Nation	Facilitate adaptive responses and new capabilities to counter increasingly agile adversaries
Sustain a Ready Force to Meet Mission Needs	Use AM to create a more resilient supply chain and enable in-theatre manufacturing
Strengthen & Enhance the Health & Effectiveness of the Total Workforce	Enable cost-effective personalized products and therapies to increase warfighter health
Achieve Dominant Capabilities through Innovation & Technical Excellence	Increase system availability (readiness), and Produce novel, high performance parts
Reform & Reshape the Defense Institution	Incorporate supply chain and production benefits of AM into DoD operations

KEY TAKEAWAYS

Opportunity of AM
AM offers considerable opportunity to enhance warfighting capabilities & create supply chain efficiencies.

Synergistic Visions
Shared visions provide an opportunity for coordination on many priorities.

Structured Format for Action
DoD AM roadmap provides a major step toward focusing AM technical development strategy.

Focus Area	Integrated Objective	Integrated Impact Statement
DESIGN drives technological advancements in new non-proprietary design methods and tools. These tools and methods are required to enable a culture change and break the cycle of designing AM parts like cast or machined parts.	DoD.D.1 – Enable Robust, Integrated, and Intelligent Design Tools	*Streamline design process, reduced cycle time, and higher performance products*
	DoD.D.2 – Enable Design for AM	*Increase capability rapidly delivered to warfighter*
	DoD.D.3 – Improve Reverse Engineering Capabilities	*Push AM forward, enabling increased self-sufficiency of units and innovation by users in the field*
	DoD.D.4 – Develop Design for Function (Application-based Design) Guidelines	*Apply AM to meet specific weapons systems requirements*
MATERIAL builds the body of knowledge for benchmark AM property characterization data and eliminating variability in "as-built" material properties. It also focuses on accelerating advanced material development through computational modeling and advanced simulation.	DoD.M.1 – Define Standard AM Materials Requirements	*Enhance predictability of resulting part performance using an interoperable framework for AM at DoD*
	DoD.M.2 – Establish Vendor Qualification and Encourage Expansion of Material Sources	*Increase the range of materials available to designers, enhancing part performance*
	DoD.M.3 – Develop AM Materials	*Establish priorities for AM material development activities necessary to meet DoD requirements*
	DoD.M.4 – Create Defined and Accessible Pedigreed Datasets and Schemas	*Establish authoritative data sets for simulation and reference*
	DoD.M.5 – Establish a DoD-wide Materials and Process AM Data Repository	*Establish a single repository of material, process, and performance data. Speed up research, enable quality*
	DoD.M.6 – Develop Model-based Approaches to Accelerate Materials Qualification and Certification	*Guarantee quality of AM parts*
PROCESS drives technological advancements that enable faster, more accurate, and higher detail resolution additive manufacturing machines with larger build volumes and improved "as-built" part quality.	DoD.P.1 – Develop NDE and Process Control	*Enhance the sensing capability of machines, gather data to ensure quality*
	DoD.P.2 – Establish Stable and Robust AM Processes	*Enable broader application of AM through process stability and equipment ruggedization*
	DoD.P.3 – Develop Open Architecture Equipment	*Ensure transferability and interoperability through specifications and standards*
	DoD.P.4 – Modify Existing or Develop New Process Capabilities	*Modify or develop processes to increase the applicability of AM in a variety of situations*
VALUE CHAIN encourages technological advancements that enable step change improvements in end-to-end value chain cost and time to market for AM produced products.	DoD.V.1 – Build Cost Models and Decision Tools	*Understand when, where, and how to apply AM*
	DoD.V.2 – Develop Qualification and Certification Methods for Parts and Systems	*Guarantee quality of parts and interface with existing/new DoD policies*
	DoD.V.3 – Establish Cyber Infrastructure and Cyber Security	*Enable secure information technology infrastructure for end-to-end connectivity of the manufacturing process*
	DoD.V.4 – Establish Physical AM Infrastructure	*Install AM machines across DoD enterprise*
	DoD V.5 – Business Practices – Intellectual Property, Data Rights and Contracting Issues specific to AM	*Establish agreed-upon business practices to ensure seamless integration of AM into the existing supply chain*